The Political Economy of Car Sales in Athens, Greece

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2014

13th Annual Conference of Greek Historians of Economic Thought, University of Athens, Athens, Greece; 6-7 June 2014.

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Abstract: Greece is widely hailed to be among the most prominent victims of the recent global recession since the downfall of its economic activity, caused by local and international factors, has reached levels that are directly comparable to the Great Recession. In this context, we attempt to shed light on a prominent victim of this situation, i.e. the car sales industry in Athens, Greece over the time period 2000-2012 using monthly data. To this end, an appropriate econometric model, that incorporates a large number of potential determinants which account for the relevant factors, is used and several econometric techniques are employed such as stationarity testing; filtering; white noise testing; periodicity analysis; correlation analysis and causality testing. Our empirical investigation determines the macroeconomic and other variables that act either as pro- or countercyclical factors in business cycles fluctuations of the car sales industry in Athens.

Keywords: Business Cycles, Fluctuations, Crisis, Car Sales, Athens.

1. Introduction

Just a few years ago, Greece had a developed economy with the 22nd highest standard of living in the world (Economist, 2005) and a 'very high' Human Development Index, ranking 25th in the world (United Nations, 2009). However, in 2010 as a result of international and local factors, the Greek economy Greece faced a severe economic crisis. In fact, it experienced the second highest budget deficit and the second highest debt to GDP ratio in the EU, which in combination with the high borrowing costs, resulted in a severe crisis (Charter, 2010). Since then a number of austerity measures have been implemented by the so called Troika, i.e. ECB/EU/IMF.

Actually, Greece constitutes the first EMU country where a sovereign debt crisis made its appearance, after the introduction of the common currency. In view of this tremendous change, it is evident that Greek GDP has fallen dramatically by approximately 20% (BoG, 2013). In this context, the majority of Greek sectors face the severe consequences of the crisis. To this end, the impact of the Greek crisis to specific sectors of the economy is of great interest.

So far, a number of works have attempted to assess the performance of the Greek economy after World War II (e.g. Ioakimoglou and Milios 1993, Alogoskoufis 1995, Tsakalotos 1998, Bosworth and Kollintzas 2001, Christodoulakis et *al.* 1996, Tavlas and. Zonzilos 2001, Skouras 2001, Giannitsis 2005, Apergisand Panethimitakis 2007, Kollintzas and Vassilatos 1996, Michaelides et *al.* 2013 Milios 2013, Kouretas and Vlamis 2010, Apergis 2013). In brief, there is widespread agreement among the various authors that the Greek economy, just like most developed economies, entered a protracted period of recession in the mid-1970s which interrupted the steady growth initiated by the wave of industrialization in the 1960s. The macroeconomic policies of the 1980s are related to this slowdown. A common point of most conventional analyses is the concentration of macroeconomic policies on the demand side and more specifically on consumption, neglecting both investments and the supply side of the economy. Also, an

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important change in the policy regime occurring in the 1990s is noted, which led to an acceleration of growth while restoring economic stability. The fact that Greece suffers from output fluctuations should be carefully examined.

The car sales sector is an important sector for the Greek economy since it accounts for a significant part ofgovernment revenues, especially through the registration taxes that are directly implemented whenever a car sale takes place as well as through the presumptions implemented once a year. The car sales sector in Greece was significantly affected by the ongoing crisis with a reduction of total sales that exceeded 20% (Roul et *al.* 2012) which in turn affected government revenues. To this end, the Greek Government was forced to counter balance the revenue losses through alternative austerity measures. Hence, it is of outmost importance to investigate the determinants of the car sales industry business cycles since they deserve careful screening by policy circles.

The paper contributes to the literature in the following ways: It the first to the best of our knowledge that investigates the determinants of car sales business cycles in the area of Athens; It provides a compact methodological framework that is suitable for this type of investigation; It utilizes an extensive data set in monthly format accounting for the period 2000-2012, fully capturing the Greek crisis.

2. Methodology

Defining Business Cycles

First, we define the concept of business cycles. Hence, we regard business cycles as fluctuations around a trend i.e. "deviation cycles" (Lucas 1997). The business cycle component is regarded as the movement in the time series that exhibits periodicity within a certain range of time duration based on Burns and Mitchell (1946), and in line with NBER In this context, any macroeconomic time series can be decomposed into a trend and a cyclical component as follows:

$x_t = c_t + g_t$ (1)

where x_t, is a macroeconomic time series, g_t is the trend that the time series exhibits and c_t is its cyclical component.

Filtering

A very popular and appropriate method for extracting the business cycle component is the Baxter-King (BK) Filter (Baxter and King 1999) since a large number of studies have used it, as of yet (e.g. Stock and Watson 1999, Agresti and Mojon 2001, Benetti 2001, Massmann and Mitchell 2004). The Baxter King filter is based on the idea of constructing a band-pass linear-filter that extracts a frequency range corresponding to the minimum and maximum frequency of the business cycle. The algorithm consists of constructing two low-pass filters. The first passes through the frequency range $[0,\omega_{\max}]$, denoted $\overline{a}(L)$, where L is the lag operator, and the second through the range $[0,\omega_{\min}]$, denoted $\underline{a}(L)$. Subtracting these two filters, the ideal frequency response is obtained and the de-trended time series is $y^{BP}(t)=[\overline{a}-\underline{a}]\,y(t)$

Testing for white noise

Having extracted the cyclical component we test whether it represents a cycle by testing if it corresponds to a white noise process or not, using the Ljung and Box (1978) test (Q-stat). The sample AC function measures how a time series is correlated with its own past history; in order to test for AC we use the Ljung and Box (1978) test (Q-Stat.) which practically tests the null hypothesis of white noise for a maximum lag length k:

$$Q = n(n+2)\sum_{j=1}^{h} \frac{\hat{p}_j^2}{n-1}$$

where n is the sample size, $\hat{p}_j$ is the sample AC at lag j, and h the number of lags being tested; for significance level a, the critical region for rejection of the hypothesis of randomness is

$Q > \chi^2_{1-a,h}$ the a-quantile of the chi-squared distribution with h degrees of freedom; the alternative hypothesis is that at least one of these ACs is non-zero, so that the series is not white noise. In case the null hypothesis is rejected, then the underlying time series is not white noise and is considered a cycle.

Extracting Periodicities

Next, using spectral analysis, we investigate the periodicities of business cycles, meaning the average length of the cycles based on the Fourier-transformed function of the cycle. See, for instance, Iacobucci (2003) and Owens and Sarte (2005). Using standard notation, a periodogram is a graph of the spectral density function of a time series as a function in natural frequency domain. The function has the following form:

$$f(\omega) = \begin{cases} f(1-\omega), \text{ if } \quad \omega \in [0.5,1] \\ 1/n\left|\sum_{t=1}^{n} x(t)e^{2\pi i(t-1)\omega}\right|, if \;\; \omega \in [0, 0.5) \end{cases}$$

where $\omega = 2\pi / n$ is the natural frequency and x(t) is the time series.

The intuition of the above Fourier transformation is:(i) it first standardizes the amplitude of the density by the sample variance of the time series, and (ii)it then plots the logarithm of that standardized density. Peaks in the periodogram represent the cyclical behavior (frequencies) of the data.

Unit Root Test

In order to avoid the spurious regression effect we examine the stationary characteristics of all variables that enter the model. To this end, we use the Augmented Dickey – Fuller methodology (ADF) (Dickey and Fuller, 1979). The ADF test is based on the following equation :

$$\Delta Y_t = \alpha + bt + \rho Y_{t-1} + \sum_{i=1}^{m} \gamma_t \Delta Y_{t-1} + \varepsilon_\tau$$

where Δ is the first difference operator, t is time and ε is the error term:

(a) if b≠0 and -1<ϱ<0 implies a trend stationary model;

(b) if b=0 and -1<ϱ<0 implies an ARMA Box/Jenkins class of models;

(c) if b=0 and ϱ=0 implies a difference stationary model where Y variable is integrated of degree one I(1).

Cointegration

Also, in case that the variables were found to be I(1) we have to check for cointegration between them, since if cointegrating relationships are present then the Error Correction Terms have to be employed in the estimation of the model. We employ the popular Johansen (1988) methodology that allows for more than one cointegrating relationship, in contrast to other tests. The methodology is based on the following equation:

$$\Delta y_t = m + \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + e_y$$

$$\text{where } \Pi = \sum_{i=1}^{p} A_i - I \quad \text{and} \quad \Gamma_i = -\sum_{j=i+1}^{p} A_j$$

The existence of cointegration depends upon the rank of the coefficient matrix Π which is tested through the two likelihood ratios, namely the trace test and the maximum eigenvalue test, respectively, described by the following formulas:

$$\left\{ \begin{array}{l} J_{trace} = -T \sum_{i=r+1}^{k} \log(1-\lambda_i) \\ J_{\max} = -T \log(1-\lambda_i) \end{array} \right\}$$

where T is sample size and λ_i is the largest canonical correlation.

The trace test tests the null hypothesis of r<n cointegrating vectors, whereas the maximum eigenvalue test, tests the null hypothesis of r < r+1 cointegrating vectors and the critical values are found in Johansen and Juselius (1990).

Short run causality

In order to account for the timing pattern of causalitywe adjust the concept of short-run and long-run causality measures introduced by Dufour and Renault (1998), and extended in Dufour et *al.* (2006), so as to fit the variables of interest. The test of the hypothesis that is not causal for *x (t)* at horizon *h=1, 2,…* is now based on the following model :

$$x_{i,t} = \alpha_i + \Phi_i(L,P_i)x_{it+h} + \Lambda_i(L,\Omega_i)x^*_{i,t+h} + \Psi_i(L,R_i)WG_{t+h} + u_{i,t+h} \quad (15) \ \forall\, h\ 1,2,\ldots H$$

For $i = 1,2$ and $t = 1,\ldots,T$ where: x_{it} is the vector of endogenous country domestic variables; $\Phi_i(L,P_i)$ is the matrix of lag polynomial of the associated coefficients; α_i is a vector of fixed intercept; WG_t is a vector of deterministic global variables; $\Psi_i(L,R_i)$ is the matrix of lag polynomial of the associated coefficients; and $\Lambda_i(L,\Omega_i)$ is the matrix of lag polynomial of the foreign specific variables x^*_{it}.

The null hypothesis of no causality at time horizon *h* implies that the vector of coefficients b_{ij} of the weighted variables $x^*_{i,t}$ for each country $i = 1,2$, the country specific variables x_{it} and the Global variables WG_t, are such that b_{ij}=0, $\forall j \neq h,\ j \in \{1, \dots \Omega_i\}$ for each country i=1, 2 which can be routinely tested using a test that is asymptotically chi-squared distributed with *Ωi* degrees of freedom. Also, if $x^*_{i,t}$ is not causal for $x_{i,t}$ at time horizon *h** then this is also the case for all *h>h**. Finally, note that the notation can be easily generalized for the general case with i ∈ {1, .., N} and k_i={1, .., K}.

for the period 2000-2012, when data are available. Specifically:

where: $TScycle_t$ is the cyclical component of Total car sales in Athens, extracted by means of Baxter King Filtering; $GDPcycle_t$ is the cyclical component of Greek GDP extracted by means of Baxter King Filtering; UN_t is the Greek unemployment; GDP_t is the Greek GDP; F_t is the fuel price; C_t is the dummy variable of Crisis taking the value of 1 in time interval (2010 (M4)-2012 (M12)) and 0 elsewhere; P_t is the dummy variable of presumptions taking the value 1 in the time period 2009 (M5)-2009 M(8) and 0 elsewhere; RT_t is the dummy variable of the registration taxes taking the value of 1 in the period 2004 (M1) - 2008 (M12) and 0 elsewhere and L_t is the dummy variable of theloans directed to the car market taking the value 1 for the period 2003 (M1)- 2008 (M12) and 0 elsewhere.

3. Empirical Analysis

3.1 Data and Variables

The data used are monthly, and cover the period 2000-2012. The data regarding Total Car Sales in the Area of Athens come from AMVIR (Association of Motor Vehicle Importers Representatives); Unemployment and GDP come from El.Stat, while the data on Fuel prices come from the Observatory of Fuel Prices. All quantitative variables in the model are in constant 2005 prices in millions of euros, whereas the econometric analysis was performed using the statistical package Stata 12.

3.2 Business cycles

We begin our analysis by extracting the business cycles components from the variables of Greek GDP and Car Total Sales in Athens, applying the Baxter King filtering technique described in the previous section. To this end, in order to examine whether the alleged extracted cyclical component could be considered a cycle and are not mere random walkwe test for white noise. Table 1 presents the white noise test results of the aforementioned variables.

Table 1 : Pormanteau White Noise test

Variables	Q-test	p-value	White noise
GDPcycle	998.35	0.00	No
Car Total Sales cycle	258.76	0.00	No

The results suggest that neither of the variables are white noise and, hence, could be consideredas cycles, from an econometric point of view.

We continue by investigating the periodicities that these cyclical components exhibit. In this context, Figures 1-2 depict the periodograms of the cyclical variables.

Figure 1: Periodogram of Car Total Sales cycle

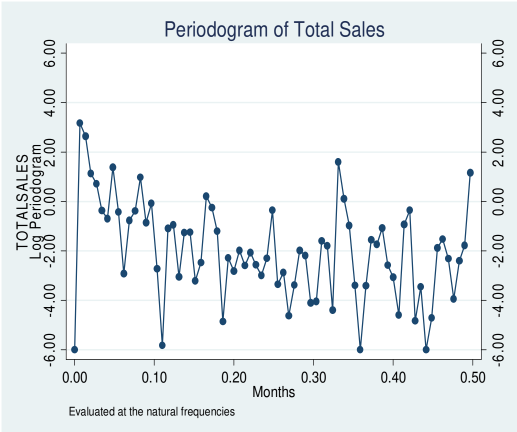
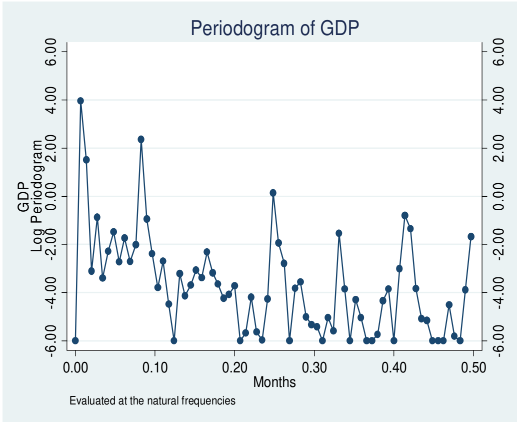


Figure 2: Periodogram of GDP cycle



The results suggest that both Car Total Sales and GDP cycles exhibit a short-term and a medium term cycle. More specifically, Car Total sales exhibit a short-term cycle of approximately 12-14 months (≈1 year) that could be considered as inventory cycle, while it also exhibits a medium-term cycle of approximately 58-60 months (≈5 years) which in turn could be considered as a fixed investments cycle. Now, as far as the Greek GDP is concerned, we also witness a short-term cycle of approximately one year and a medium-term cycle of approximately four years. The short term cycle could be attributed to the delay of fiscal adjustment implemented by the Greek government to the monetary policies implemented by the ECB, while the medium-term cycle could be attributed to the idiosyncratic characteristics of the Greek economy that provide the economy with extra stimulus, such as the Olympic games.

3.3 Stylized Facts

Next, we continue our analysis by presenting some stylized facts regarding the quantitative variables that enter our model, which account for both the macroeconomic conditions of the Greek economy and the idiosyncratic nature of the Car sales industry. In this context, Figures 3-5 present the evolution of the key macroeconomic determinants of Greek GDP, Greek GDP cycle and Unemployment that presumably influence the Car Total Sales cycle, while Tables 6-7 present the evolution of the industry specific variables.

Figure 3: Greek GDP

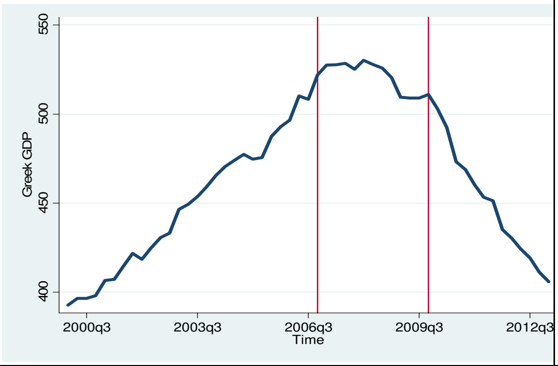


Figure 4: Greek Unemployment

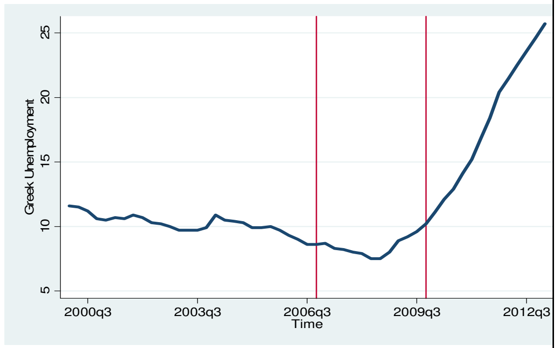


Figure 5: Greek GDP cycle by Baxter King

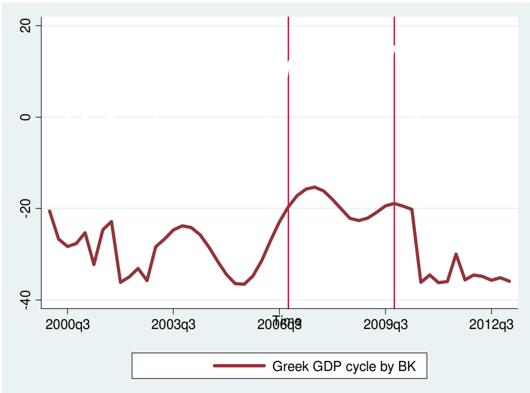


Figure 6: Fuel Price

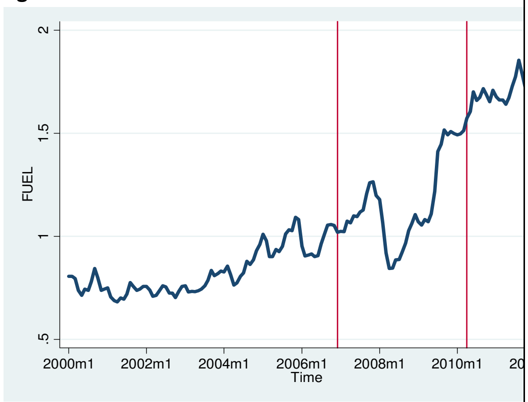
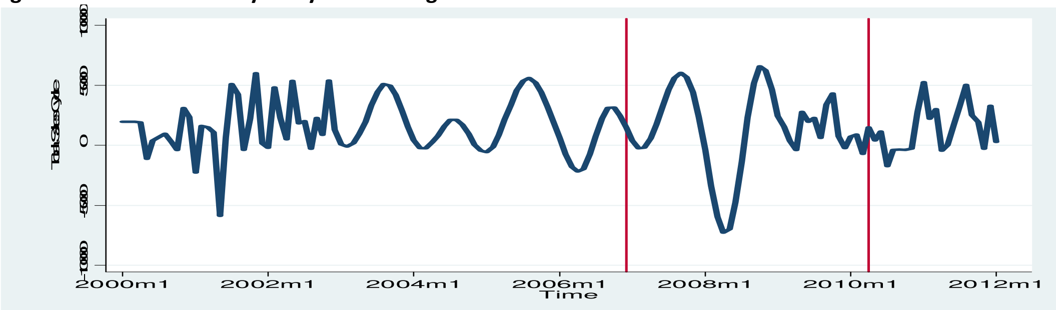


Figure 7: Car Total Sales Cycle by Baxter King



According to Figure 1, Greek GDP is characterized by an upward trend at the beginning of 2000 which is interrupted by the collapse of Lehman Brothers in 2006 (Q4) that signified the start of the US mortgage crisis.The decline of Greek GDP continued with relatively slow pace until the outburst of the Greek Debt crisis of 2010 (Q1) when this pace increased significantly, probably as a result of the austerity policy implemented by the so called 'troika' (EMU/IMF/ECB). Next, turning at Figure 2, Unemployment, is characterized by a downward trend which is interrupted almost a year after the Global recession and from then on started climbing with an enormous pace especially after 2010.

According to Figure 3, we observe two major cycles in the Greek GDP, which are characterized by different periods and amplitudes, i.e. time intervals between two consecutive peaks and intensity respectively. The first cycle is around 2004 and could be primarily attributed to the Olympic Games. This cycle is characterized by a period of approximately 3 years. The second cycle is around 2007 and could be initially attributed to the global crisis while it continues uninterrupted until the end of the period of our investigation, a fact that could be attributed to the ongoing Greek Debt crisis.

Apparently, its period is over 5 years, while its intensity, when compared with the cycle of the Olympic Games, is substantially higher. In Figure 4, we observe that Fuel price is characterized by an upward trend that collapses at 2008 and continues to increase with a faster pace just before the Greek crisis.

Finally in Figure 5, we observe that Total Sales cycle could be decomposed into four (4) distinct cycles which are characterized by different periods and amplitudes. The first cycle is in the beginning of the 2000s and is characterized by sharp fluctuations and a very short period of less than six (6) months. This cycle seems to be an adjustment cycle attributed to the introduction of the euro currency. The second cycle is around 2004 and could be primarily attributed to the Olympic Games. This cycle is characterized by a period of approximately one (1) year, while we also witness increased amplitudes when compared to the first cycle. The third cycle begins after the global crisis and is characterized by increased amplitudes while the period remains unaffected to approximately one (1) year. Lastly, the fourth cycle takes place after the Greek crisis and is characterized by sharp fluctuations with a small period at approximately six (6) months. It looks like the adjustment cycle in the beginning of 2000.

3.3 Econometric Analysis

Before turning to the estimation of our model we have to examine the stationarity characteristics of the time series.In principal, we ought to either consider stationary variables, if cointegration is not present among the variables, or additional error correction terms so as to capture the potential long run relationships between the variables (e.g. Koop 2004).According to Table 1, the majority of time series variables were found to be non-stationary, except for the cyclical components of GDP and Car Total Sales that were expected to be found stationary. Nevertheless, all variables exhibit stationarity in first differences (Table 3). In this context, all variables with the exception of the cyclical variables are regarded to be integrated of degree one i.e.I(1).

Table 2: ADF test original variables

Variable	p-value	Stationarity
GDP	0.36	No
Unemployment	0.99	No
Fuel price	0.59	No
Tscycle	0	Yes
GDPcycle	0.03	Yes

Table 3: ADF test First Differenced variables

Variable	p-value	Stationarity
GDP	0	Yes
Unemployment	0.04	Yes
Fuel price	0.01	Yes

In the presence of I(1) variables we have to examine the existence of cointegrating relationships. To this end, Table 4 presents the results of Johansen's test.

Table 4: Johansen Cointegration Test

max rank	Log Likelihood	Eigenvalue	Trace statistic	Critical values	Cointegration
0	-2490.57		156.69	47.21	No
1	2461.04	0.34	97.61	29.68	
2	2435.42	0.3	46.39	15.41	
3	2418.09	0.22	11.73	3.76	
4	2412.23	0.08			

The results indicate that there is no cointegration among the variables that enter our model. In this context, we will proceed to the model estimation using stationary variables by employing the Huber-White estimators, so as to account for heteroskedasticity. Table 5, presents the estimation results.

Variables	Coefficients	t-stat
$GDPcycle_t$	0.09	3.15*
UN_t	-11.23	-2.55*
GDP_t	-0.11	-4.26*
F_t	16.65	4.6*
C_t	-6.64	-2.69*
P_t	3.97	2.54*
RT_t	11.25	5.20*
L_t	2.8	2.33*
Intercept	65.35	3.62*
F-stat	78.93	
R-adjusted	0.78	
Durbin-Watson	1.86	
		* denotes statistical significance in 5% level or higher

In general, the results suggest that our model has a high F-statistic which is very satisfactory for this type of investigation in the sense that, overall, the estimated coefficients of our model are statistically significantly different than zero. All variables of the model are statistically significant at the 5% level or higher, while the model is able to interpret 78% of the variance that the data exhibit. Finally, according to the Durbin-Watson statistic, there is no evidence of serious autocorrelation of the residuals.

Next, turning to the effect on Car Total Sales of the variables that enter our model, we witness that Greek GDP has a negative and statistically significant impact on the Total care sales cycle in the area of Athens, suggesting that a rise in total output of the Greek economy acts as a stabilizer of the Car Sales cycle. This could be attributed to the fact that in the booming periods of the Greek economy, which imply good economicand financial condition, the cycle of Total Sales becomes less acute or even insignificant. Moreover, Greek GDP cycle has a positive and statistically significant impact on Total car sales cycle. Therefore, Greek GDP cycle is pro-cyclical to Total Car Sales cycle in the sense that an expansion of Greek GDP cycle would lead to an increase of the Total Car Sales. This, in turn, suggests that the two cycles are interconnected, since in recessionary periods the destabilization of GDP cycle would consequently lead to the destabilization of Total Car Sales cycle. Fuel price has a positive and statistically significant effect on Total Car Sales cycle. In this context, it has a pro-cyclical character in the sense that a rise of fuel price will result in a destabilization of the Total Sales Cycle, since fuel price is hailed to be the most significant cost for car owners in a daily basis.Greek unemployment has a negative and statistically significant impact on Total Sales cycle, which in turn implies that unemployment has a countercyclical character in the sense that it stabilizes the cycle of Total Sales. This could be attributed to the fact that as unemployment rises car ownership becomes more difficult since the population does not have the required funds for either the purchase of a car nor its daily maintenance, leading Car Sales cycle to a lower level of fluctuations.

Turning to the key dummy variables that enter our model,which characterize the macoreconomic environment of the Greek economy as well as the idiosyncratic characteristics of the Total Car Sales industry we can see that the Greek crisis has a negative and statistically significant impact on Total Car Sales cycle in the area of Athens, which in turn implies that the crisis tends to stabilize the cycle of Total Car Sales. This could be attributed to the fact that, due to the Greek crisis, the austerity measures implemented led car sales to a significantly lower level without significant fluctuations. The dummy variable of Loans has a positive and statistically significant effect on Total Car Sales in the area of Athens, which implies that it has a pro-cyclical character. This fact is fully anticipated since the favorable loan terms that either the banks or the car dealerships offered their customers increased significantly the incentive of people to purchase cars, and thus led to less acute fluctuations.The dummy variable of Car Registration Taxes has a positive and statistically significant impact on Total Car Sales cycle. The procyclical character of the variable could be attributed to the fact that the government put forward a legislation leading to a reduction of 50% in the Registration Taxes [2009(M5)-2009 (M8)]. Finally, the positive effect of presumptions could be attributed to the same incentive mechanism since the Greek government offered practically zero presumptions for any car purchase after 2004 and up until 2008 that would have a factory price of less than 50.000 euros.

4. Conclusion

The Greek crisis has reached points that are directly comparable to the Great Recession including an approximate 20% contraction of GDP in the period 2008-2013 and a very high unemployment rate equal to 27%. This paper aims at uncovering the determinants of Total Sales cycle of cars in the area of Athens by means of key Political Economy variables (GDP, business cycle, unemployment rate, fuel price) and key dummy variables that further characterize the Political, Economic and Social situation in Greece and the Car sales industry in Athens, over the last 12 years, using monthly data.

The results of our investigation suggest that the Total Car Sales cycle in the area of Athens is positively affected by the key macroeconomic variable of Greek GDP cycle and the key variable of Car Sales sector, the Fuel price, as well as by the key dummy variables that characterize the sector of Car sales namely: Registration Taxes, Presumptions and Loans. The aforementioned variables were found to have a pro-cyclical character in the sense that they destabilize the cycle of Total sales mainly due to the strong interconnection between them (GDP cycle) or due to an incentive mechanism that was put forward by policies implemented in the sector.

On the other hand, the macroeconomic variables of Greek GDP, unemployment as well as the key dummy variable of Greek crisis were found to affect negatively the Total Car Sales cycle. Their counter-cyclical character could be attributed mainly to the strict institutional changes implemented and resulted through different mechanism to the decreased fluctuation of Total Car Sales. No doubt, future research on the subject could be of great interest as the car sales industry constitutes an important part of the Greek economy.

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